A systematic review of motives for densification in Swedish planning practice

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Abstract. One of the current dominant strategies proposed for sustainable urban development is densification. While some advocate the very reasonable benefits of density, others emphasize the potential drawbacks. The main goal of this paper is to provide a systematic overview of the claimed benefits of densification in Swedish practice and relate this to the scientific evidence. For the systematic overview, comprehensive plans from 59 Swedish municipalities, covering plans from both highly urbanized areas as well as more rural regions, are included. The results show that in three out of four cases where density or densification is mentioned, no motive is given. For the other quarter, the most often used motivation is related to transport (19%), services (17%) and urban environmental qualities (14%). The least frequent motives used are related to health (8%) and ecology (2%). The motives in comprehensive plans are for the most part pointing to a positive impact of density on sustainable urban development (77%), which is not always supported by the empirical evidence that more often describe a negative correlation. Furthermore, many of the most frequently used motives in comprehensive plans have little scientific support, which puts new questions on the research agenda.

1. Introduction

Global urbanization is proceeding at an unprecedented rate [1], resulting in fierce competition between land uses. The compact city approach has gained global impact as a planning approach since the 1990s [2], which, through densification and compact building, provides several environmental gains, especially related to the reduction of greenhouse gas emissions, innovation and proximity to service [3]. Density as a concept in urban planning and design was introduced in the second half of the nineteenth century to control fires, disease and social disorder that was argued to be related to high densities in industrializing cities [5]. As a result, planning controls were developed that prescribed maximum densities, e.g. through building ordinances [6]. Today, high densities are judged by many to be the best response to counter current problems such as climate change, land fragmentation and loss of biodiversity. The UN-supported Millennium Ecosystem Assessment [7] and the American EPA [8] argue for city compaction as an environmental benign strategy. Another example is UN Habitats [9] recommended density of over 150 inhabitants per hectare to arrive at more sustainable urban development. There seems to be consensus that sprawling cities, private mobility and high levels of energy consumption go hand in hand [10]. Advantages of higher densities are better accessibility to

municipal service opportunities [11], public transport [6] and innovation and productivity [3]. However, there are also negative effects associated with higher density such as well-being, social conflicts and decreasing capacity to absorb rainfall. More recently, the negative correlation between biodiversity and increased urban density has frequently been discussed [4].

This paper aims at providing an overview of motives for densification as expressed in Swedish urban development policy documents, with a focus on comprehensive plans. The Swedish case is chosen because it is often discussed as a showcase for sustainable urban development (with examples such as Hammarby Sjöstad and Norra Djurgårdsstaden). Further, focusing on one country allows for comparison of plans developed under comparable circumstances (reasonably common juridical, political and cultural frameworks), but with varying population densities. The systematic review will give insight in the arguments used most frequently and allow us to identify matches and mismatches between contemporary Swedish planning practice and the state of research using a parallel systematic review covering 330 scientific articles. The findings of this article review are discussed in detail in [12].

The objective of the current policy review is thus to map the arguments used for densification in urban planning today and compare this to the scientific evidence found. The two main research questions are: *What are the main motives used for densification?* and *How do these match with evidence found in research?* The results are used to answer the overarching research question about which arguments are used in relation to densification as a means to contribute to one of the sustainable development goals (SDG) of the United Nations ´Sustainable cities and communities´ (SDG11). Furthermore, the mirroring of these findings with the scientific evidence provides insight whether these arguments build on evidence and, if not, whether arguments and strategies should be modified. We do not address SDG11 directly but through arguments used for densification that can be related to other SDG such as good health and well-being (SDG3), inequality (SDG10), climate change and its impacts (SDG13) and biodiversity (SDG15).

The outline of the paper is as follows. In the next section, the method for the systematic review is described. In the following section, the quantitative synthesis is discussed and results from the reading of the comprehensive plans are mirrored in results from the article review. The last section discusses these findings in relation to sustainable urban development by highlighting matches, mismatches and ambiguities. This will be used to define recommendations for practice and an agenda for future research.

2. Method

For the systematic review of Swedish comprehensive plans, a representative sample of 59 plans from the 290 municipalities in Sweden, is selected. [5] Comprehensive plans are politically established policy documents that each municipality is obliged to have and needs to be evaluated, updated or revised once every election term (every fourth year). The review includes comprehensive plans from 2000 to 2019 (of which 85% are less than ten years old). Further, because it is expected that density is a strategy more often discussed in municipalities including larger cities and because these are much fewer in number, all municipalities with more than 100.000 inhabitants are included. This includes the three largest municipalities with more than 300.000 inhabitants (Stockholm, Gothenburg and Malmö) and thirteen municipalities between 100.000 and 300.000 inhabitants. Of the 274 smaller municipalities (with less than 100.000 inhabitants), a random selection of 43 municipalities is included in the final sample. The results of the review are assessed using a priori defined questions. This allows for a systematic and transparent assessment of the comprehensive plans that can be discussed with a high level of objectivity. The following questions are used to systematically summarize the selected comprehensive plans:

1. How often is density mentioned (i.e. simple count)?
2. Which motives are used in relation to densification?
3. Is the expected outcome deemed to be positive or negative for sustainable urban development?

[5] We planned to include 60 municipalities, but Örebro's comprehensive plan (part of the random selection) was excluded because the municipality has a digital plan with interactive maps, but no comprehensive text.

For the systematic review, we used the search function of Adobe Acrobat to find the keyword ´density´ as well as related terms such as ´dense´ and ´densification´ and some opposing term for dense such as ´sprawl´ and ´dispersed´.[6] All hits are registered as simple counts and if a motive is mentioned in the same sentence or paragraph that clearly links to density, this argument is noted. The motives are in a next step categorized as having a positive or negative contribution to sustainable urban development. In most cases this is rather straight forward such as preserving limited resources – a fundamental sustainability principle - while it is more challenging in other areas such as economics where in cases of a high level of ambiguity, the contribution is defined as neutral.[7] The motive must have a clear semantic relation to the keyword in order to be included in the analysis. The search does not include any results from images, captions, maps, illustrations or headings. Besides an overview of motives used in the comprehensive plans, we also discuss whether the degree of urbanization plays a role in the arguments used. The hypothesis is that more urban municipalities more often highlight negative effects of densification, while less urban municipalities argue more often that densification e.g. contributes to better public finances and feasibility to maintain public services such as public transport.

3. Quantitative synthesis of results

The arguments identified in the reviewed comprehensive plans are grouped in nine categories (Table 1). These categories are further divided into sub-categories. It should be noted that these categories are designed based on the plans selected for the systematic review discussed in this paper and the parallel review of scientific articles [13].

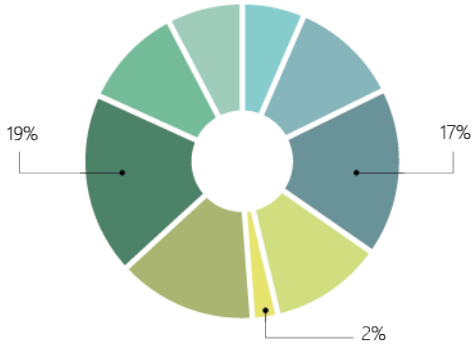
The first category, *technical infrastructure*, includes aspects related to capacity of e.g. water and sewerage that changes when more housing units are added to an area. The tree other sub-categories are surface water management, energy, and road and rail infrastructure. The second category, *resource efficiency*, covers the effective use of existing natural and land resources. It should be noted that we here only include the resource ´land´ in general terms and the resource ´natural areas including agricultural land, nature and forests´. The more economically driven resource efficiency argument is found under the category *economics*. The next main category is *service*, including the sub-categories accessibility to service; the customer base of commercial and public service; presence and accessibility of recreational green; and housing. The subsequent category *economics* includes three sub-categories: labor productivity (including innovation and entrepreneurship), property values (including housing prices) and public finances. *Ecology* includes three motives: biodiversity, mainly focusing on topics related to species diversity; ecological quality, which relates to ecosystems and their stability over time; and climate related issues in general. *Urban environment* is the category that groups all topics that describe the spatial qualities of the built environment. It covers the following four sub-categories: mixed land uses, cultural and esthetic qualities, micro-climate, and spatial qualities such as proximity. *Transport* is the category with most sub-categories. We distinguish three different modalities (public transport, pedestrian & bicycle, and car); sub-categories that relate to the use of these transport modes (car ownership, trip distance, choice of modality, and general travel behavior); energy use related to transport; and emissions related to transport. A last category is travel safety where especially traffic accidents are in focus. The subsequent category is *social impact*. Here we distinguish issues related to well-being, social interaction, social equity, and crime. The sub-category well-being or quality of life focuses on the individual, while the sub-category social interaction concerns the meeting and interaction between individuals. The last main category *human health* includes topics such as walkability and obesity, and psychological health, including stress and problems related to for instance sleep. Noise and air pollution are included as separate sub-categories as they represent the top two in disease burdens among environmental factors in Europe [13].

[6] Because the plans are written in Swedish, we use the Swedish keywords *tät*, *förtätning*, *täthet*, *gles*, *hög exploatering*, *låg exploitering*.

[7] An interpretation of the contribution to sustainable urban development has been made on basis of contemporary mainstream discourse on sustainability.

3.1. Results of the reading of 59 comprehensive plans

In the 59 comprehensive plans, the keyword density was used 3.298 times, whereof 905 times accompanied with a motive (i.e. 27% of hits have a motive). Further, in more than three out of four cases (77%) the used motives can be deemed as being in support of the argument that higher density contributes to sustainable urban development. How often different motives are used is shown in Figure 1, depicting a rather balanced spread over the different main categories, except for ecology. The most frequently used motives are transport related (19%), followed by service-related motives (17%) and arguments that are more spatial in nature (urban environment; 14%). The least frequently used arguments relate to health (8%), infrastructure (6%) and ecology (2%).



Category	Amount of arguments	Percentage
Technical infrastructure	57	6%
Resource efficiency	101	11%
Service	155	17%
Economics	103	11%
Ecology	22	2%
Urban enviorment	129	14%
Transport	172	19%
Social	94	10%
Health	72	8%

Figure 1. Distribution of the argued for relation between density and its outcome.

Despite the relatively even distribution in the main categories, a more diverse picture is found when looking at all the sub-categories (Figure 2). For infrastructure, the sub-categories surface water management and energy are the most frequently mentioned; all sub-categories related to resource efficiency are discussed equally often; service-related arguments focus mainly on accessibility, improved customer base and presence of and/or access to recreational green, while housing is least discussed. The last one is noteworthy, because densification is most often a means to provide more housing. However, this motive might seem too obvious to even be mentioned. When economics are discussed, most of the arguments relate to public finances and labor productivity. Arguments related to land and property values are largely absent. All sub-categories within ecology are discussed equally often. When the urban environment or the spatial quality is discussed in relation to density, most repeated motives concern cultural and aesthetic qualities and general spatial conditions such as proximity. Arguments related to social factors most regularly address social interaction and crime, while well-being and equity is less often referred to. Health arguments related to density are for the large majority related to noise and air pollution. Transport related motives are in two third of the cases belonging to the category sustainable modes of transport. The argument is that higher densities will contribute to more people using public transport or choosing more active modes such as walking or cycling.

The public transport motive is also the most frequently used of all sub-categories in this review, always with a deemed positive contribution to sustainable development (Figure 3). The second most frequently used argument is the role of density to create better spatial conditions in terms of general proximity. Other motives in the top-20 are public finances and a good customer base for service as well as social interaction. The motive of access to recreational green is relatively often used, but in 40% of the cases as a negative effect of densification. Other stated negative effects of densification that are frequently mentioned are noise, air pollution and problems related to surface water runoff.

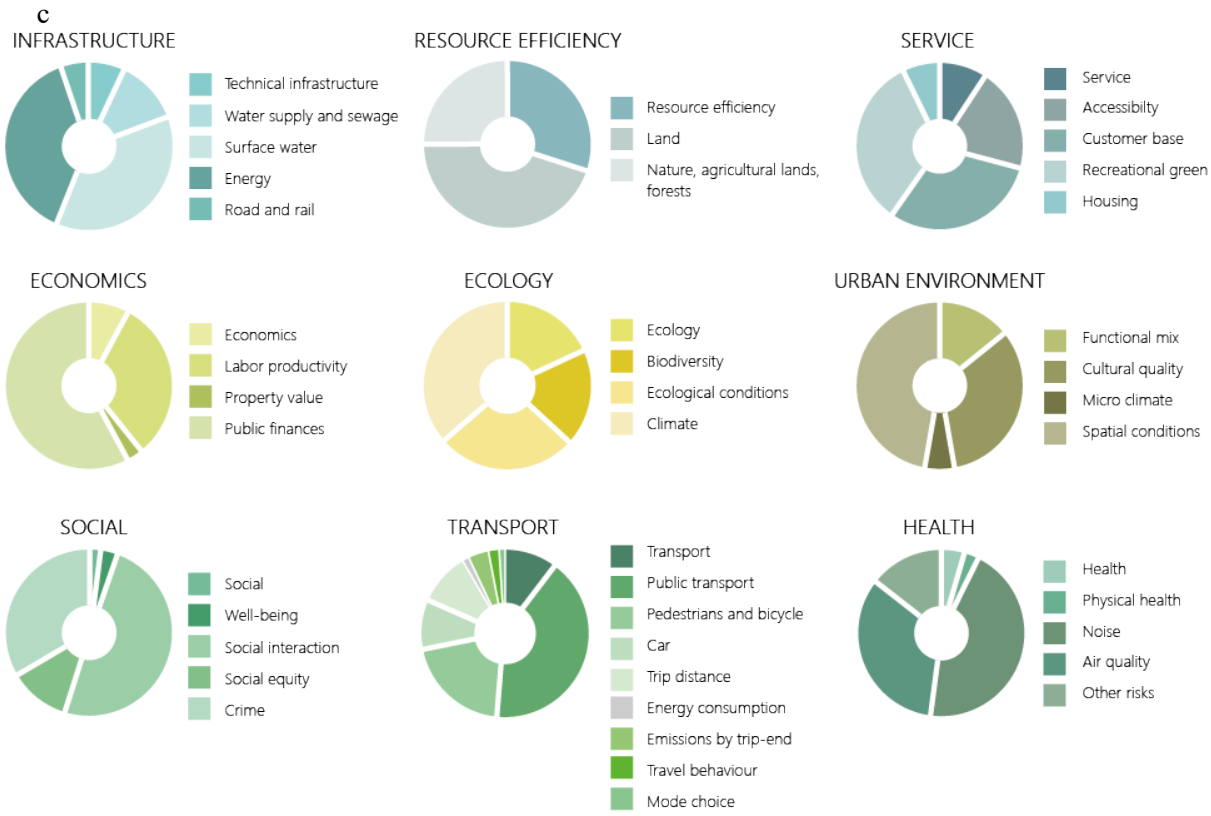


Figure 2. Sub-categories of motives and their distribution within each main category.

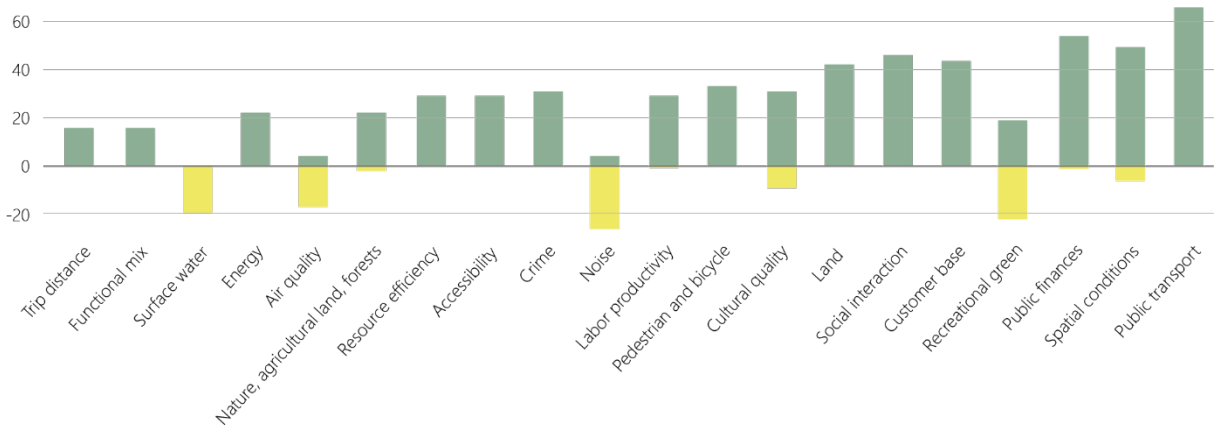


Figure 3. Top-20 of used motives where the amount of positive effects on sustainable urban development are depicted in green (positive values represent the number of registered hits) and negative ones in yellow (minus values represent the number of registered hits).

3.2. Differences between municipalities

The difference between municipalities with more versus less than 100.000 inhabitants is minimal. After dividing the sample in two, the groups are compared to the full set. No differences are found in the ratio between total hits and hits with motives and almost the same percentage argues that higher density contributes to sustainable urban development; 79% in the more populated municipalities compared to

76% in the less populated ones. In other words, the most populated municipalities do not have more, or less, arguments for higher densities, neither can they be said to value densification differently than the less populated municipalities. Regression analysis shows that population density and countryside quota correlate with the frequency the keyword density is mentioned in the comprehensive plans (i.e. number of hits), while the total number of inhabitants registered in a municipality is not significant. Population density and countryside quota together explain 22% of the variation in the number of hits. In other words, more urbanized populated municipalities use the keyword density more often in their comprehensive plans. However, there is no difference between municipalities in how often a motive is used in relation to density. To understand whether there are differences in the motives used, the overall mean population density and the mean countryside quota is compared with the means within each motive. The result shows that less urbanized municipalities more frequently use motives related to cultural quality, public transport and customer base for service. The latter two are directly related to the need for a certain population density to make service feasible while the first might concern the topic of cultural heritage where an increase in density is seen as a threat to existing cultural and esthetic qualities. For the more urbanized municipalities (with higher density and/or lower share of countryside), motives more frequently used are related to land resource efficiency, access to recreational green and surface water management. All three relate to the competition between land uses that become more severe when densities are higher. The first motive might be related to safeguarding the scarce non-urbanized land, while the second and third discuss the relation between green areas and other impervious land in the already urbanized areas that, through more densification, decrease. We can thus conclude that density is mentioned more often in more urbanized municipalities. Further, motives are used equally often, but the type of motives used differs depending on the level of urbanization.

3.3. Mirroring the results of the policy review with the scientific review

Although the main focus of this paper is not to systematically compare the patterns in motives for densification found in comprehensive plans in Sweden with scientific evidence found in international peer reviewed journals, some first preliminary findings can be discussed. For a more extensive discussion of the systematic review on empirical studies that relate density to various outcomes, see [13]. First, the argued effects and studied outcomes of densification are not distributed in similar ways (Figure 4).

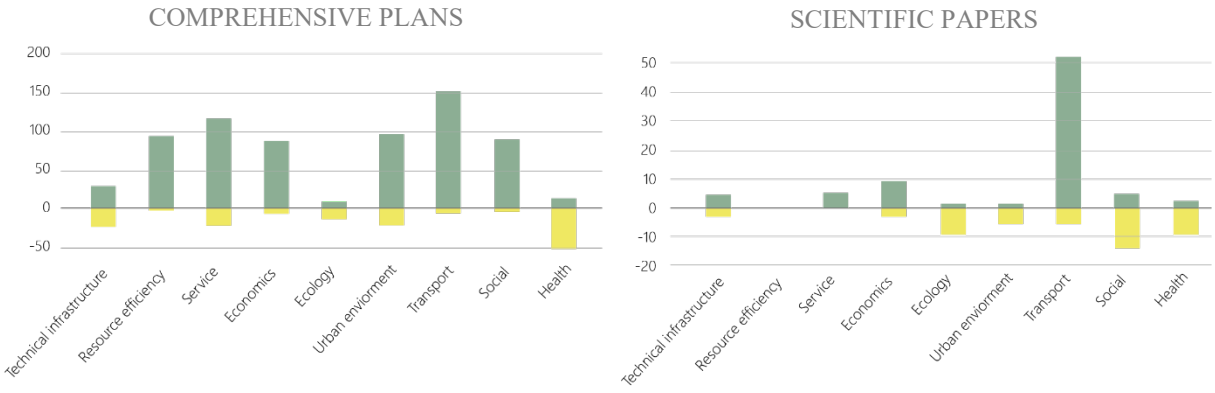


Figure 4. Main categories where the amount of positive effects on sustainable urban development are depicted in green (positive values represent the number of motive hits and papers respectively) and negative ones in yellow (minus values represent the number of motive hits and papers respectively).

The distribution of motives in comprehensive plans is relatively even, while the scientific articles primarily study transport related outcomes. This means that some motives used in planning are not well-studied. Second, the arguments in comprehensive plans are for the most part positive, while the scientific studies show a more diverse result. Density has empirically underpinned positive effects on transport

related outcomes and economics, but outcomes related to ecology, social impact and urban environment are for the most part negative. This means that practice, when measured against the scientific results, can be said to have an unbalanced bias towards a too large degree of claimed positive effects in categories central to urban and spatial planning.

The comparison between the top-20 of sub-categories found in the comprehensive plans with the evidence of density effects from scientific studies is striking. The comparison in figure 5 shows that some motives are supported by empirical findings. Examples of these are the relation between density and usage of sustainable modes of transport, public finances, air quality and surface water management. However, some motives are deemed more positive than what the evidence supports (e.g. social interaction, labor productivity, and crime), while others are too negative (e.g. recreational green). Most striking, though, is that many of the motives lack sufficient scientific support. The most frequently studied outcomes of density are in many cases not part of the top-20 motives in the comprehensive plans, e.g. physical and psychological health, well-being, safety, biodiversity and ecological conditions, micro-climate, and air quality. Moreover, the majority of the most frequently studied outcomes are negative for sustainable urban development [12].

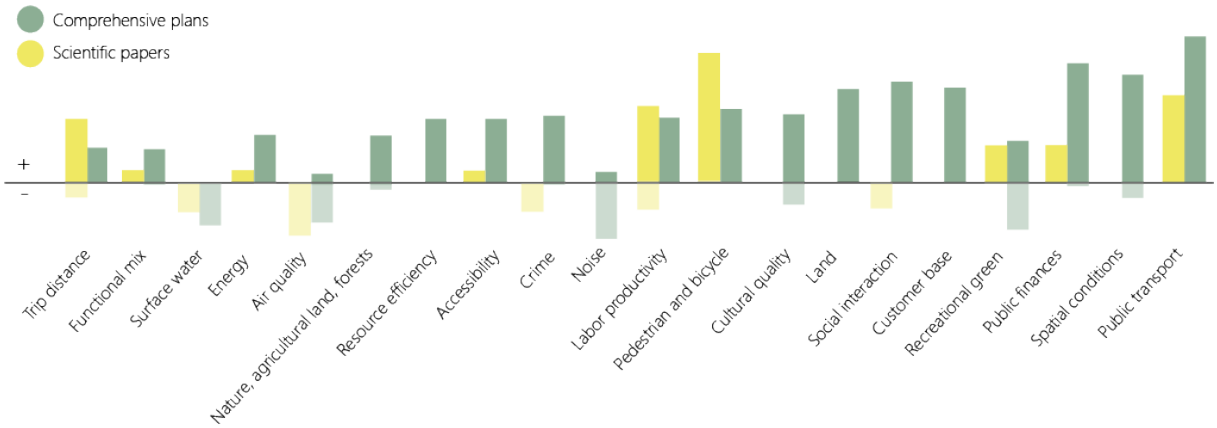


Figure 5. Top-20 of arguments used in comprehensive plans (in green) and outcomes studied in scientific articles (in yellow). On the far right, the most frequent used arguments in the comprehensive plans.

4. Conclusions and discussion

The review of comprehensive plans shows a large variation in motives related to density and densification. Few differences are found between more urban municipalities and less densely populated municipalities with more agricultural hinterland. The motives used differ slightly with, as expected, more focus on motives related to feasibility in less urbanized municipalities and on motives related to land resource efficiency, access to recreational green, and surface water management in more urbanized municipalities. Most motives found in comprehensive plans can be categorized as positive for sustainable urban development. When compared to the scientific evidence, some motives are supported, but many frequently used motives lack empirical support. Furthermore, these frequently used motives are often deemed more positive for sustainable urban development than can be scientifically supported. On the other hand, the more frequently studied outcomes in the scientific papers are less often used motives in comprehensive plans. Moreover, these scientific outcomes show for the most part a negative relation between density and sustainable urban development. This is troublesome because, on the one hand, motives are used where there is little scientific support (except for transport related motives); on the other hand, sub-categories where more scientific research is at hand - which in some cases demonstrate negative effects of densification - are the least addressed in comprehensive plans. Thus, it can be said, comprehensive plans give a too positive view on densification as a means for sustainable urban development.

Acknowledgments
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